

What is claimed is:

- 1 1. A method of forming an optical device, the method comprising:
2 fusing portions of a plurality of optical fibers to form a fused fiber region;
3 cleaving the fused fiber region to form a fused end;
4 forming a spliced fiber by splicing an end of an independent optical fiber to the fused
5 end such that the independent optical fiber is in optical communication with the plurality of
6 optical fibers; and
7 reducing a cross-section of the spliced fiber to form an optical device propagating
8 light with a lowest-order even mode.

- 1 2. The method of claim 1, wherein at least one of the independent optical fiber and the
2 plurality of optical fibers is a single-mode fiber.

- 1 3. The method of claim 1, wherein the reducing step comprises heating and pulling the
2 spliced fiber.

- 1 4. The method of claim 1 further comprising reducing the cross-section of the spliced
2 fiber to less than about 50 μm .

- 1 5. The method of claim 1 further comprising forming the optical device such that the
2 ratio of output from at least two of the plurality of optical fibers is independent of at least one
3 of wavelength of light input into the independent optical fiber, polarization of light input into

4 the independent optical fiber, temperature of the optical device, and exposure of the optical
5 device to ionizing radiation.

1 6. The method of claim 1 further comprising forming the optical device such that the
2 spectral profile of light output from at least one of the plurality of optical fibers and is
3 substantially the same as the spectral profile of light input into the independent optical fiber.

1 7. The method of claim 1 further comprising disposing a portion of the optical device in
2 a casing.

1 8. A method of forming an optical device, the method comprising:
2 forming a hybrid fiber by splicing a coreless optical fiber to a first optical fiber;
3 fusing a portion of a second optical fiber to a portion of the hybrid fiber to form a
4 fused fiber region; and
5 reducing a cross-section of the fused fiber region to form an optical device
6 propagating light with a lowest-order even mode.

1 9. The method of claim 8, wherein at least one of the first and second optical fibers is a
2 single-mode fiber.

1 10. The method of claim 8, wherein the reducing step comprises heating and pulling the
2 fused fiber region.

1 11. The method of claim 8 further comprising reducing the cross-section of the spliced
2 fiber to less than about 50 μm .

1 12. The method of claim 8 further comprising forming the optical device such that the
2 ratio of output from the first optical fiber to output of a first end of the second optical fiber is
3 independent of at least one of wavelength of light input into a second end of the second
4 optical fiber, polarization of light input into a second end of the second optical fiber,
5 temperature of the optical device, and exposure of the optical device to ionizing radiation.

1 13. The method of claim 8 further comprising forming the optical device such that the
2 spectral profile of light output from the first optical fiber and a first end of the second optical
3 fiber is substantially the same as the spectral profile of light input into a second end of the
4 second optical fiber.

1 14. The method of claim 8 further comprising disposing a portion of the optical device in
2 a casing.

1 15. The method of claim 8, wherein the fused fiber region comprises the second optical
2 fiber and at least two hybrid fibers prior to the reducing step.

1 16. An optical device comprising:
2 an input region, the input region comprising a portion of a first optical fiber and a
3 portion of a coreless optical fiber;

4 a fused fiber region in optical communication with the input region, a portion of the
5 fused fiber region having a diameter less than that of the input region; and
6 an output region in optical communication with the fused fiber region, the output
7 region comprising a portion of the first optical fiber and a second optical fiber;
8 wherein the input region, the fused fiber region, and the output region propagate a
9 lowest-order even mode.

1 17. The optical device of claim 16, wherein at least one of the first and second optical
2 fibers is a single-mode fiber.

1 18. The optical device of claim 16, wherein the cross-section of the fused fiber region is
2 less than about 50 μm .

1 19. The optical device of claim 16, wherein the ratio of output from the first optical fiber
2 to output of a first end of the second optical fiber is independent of at least one of wavelength
3 of light input into a second end of the second optical fiber, polarization of light input into a
4 second end of the second optical fiber, temperature of the optical device, and exposure of the
5 optical device to ionizing radiation.

1 20. The optical device of claim 16, wherein further the spectral profile of light output
2 from the first optical fiber and a first end of the second optical fiber is substantially the same
3 as the spectral profile of light input into a second end of the second optical fiber.

- 1 21. The optical device of claim 16, wherein the optical device comprises a casing.
- 1 22. The optical device of claim 16, wherein:
2 the input region comprises a first optical fiber and portions of at least two coreless
3 optical fibers; and
4 the output region comprises one more optical fiber than the number of coreless
5 optical fibers.
- 1 23. An apparatus comprising a first optical fiber spliced to a fused end of at least two
2 optical fibers, the first optical fiber and the fused end forming a spliced fiber region, the
3 optical fibers only propagating light with a lowest-order even mode.
- 1 24. The optical device of claim 23, wherein at least one of the optical fibers is a single-
2 mode fiber.
- 1 25. The optical device of claim 23, wherein the cross-section of the spliced fiber region is
2 less than about 50 μm .
- 1 26. The optical device of claim 23, wherein the ratio of output from the at least two
2 optical fibers is independent of at least one of wavelength of light input into the first optical
3 fiber, polarization of light input into the first optical fiber, temperature of the optical device,
4 and exposure of the optical device to ionizing radiation.

1 27. The optical device of claim 23, wherein further the spectral profile of light output
2 from the at least two optical fibers is substantially the same as the spectral profile of light
3 input into the first optical fiber.

1 28. The optical device of claim 23, wherein the optical device comprises a casing.